CONSTRUCION SAFETY IN ADDIS ABABA, THE CASE OF GRADE-1 BUILDING CONTRACTORS

TADESSE MEBRAT

MASTER OF BUSINESS ADMINISTRATION IN CONSTRUCION MANAGEMENT (MBA)

ADDIS ABABA SCIENCE AND TECHNOLOGY UNIVERSITY

FEBRUARY, 2018

Declaration

I hereby declare that this thesis entitled **"Construction Safety In Addis Ababa, The Case of Grade-1 Building Contractors."** Was composed by myself, with the guidance of my advisor, that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted, in whole or in part for any other degree or professional qualification.

Tadesse Mebrat Tegen

Signature----------

December, 2017

Certificate

This is to certify that the thesis prepared by Mr. Tadesse Mebrat Tegen entitled **"Construction Safety In Addis Ababa, The Case of Grade-1 Building Contractors"** and submitted in fulfillment of the requirements for the Degree of Master of Business Administration (MBA) complies with the regulation of the University and meets the accepted standards with respect to originality and quality.

Signed by Board of Examiners

1._____

Adviser Signature Date

2._____

External Examiner Signature Date

3._____

Internal Examiner Signature Date

4._____

Chairman Signature Date

Abstract:

This paper aims to assess construction safety among contractors mainly grade one that are working in Addis Ababa city. Safety in construction means doing construction activities with great care and minimize harm for humans, material loss and the environment degradation. Construction safety consideration is required at all stages of construction process which are, feasibility stage, design stage, construction stage, operation stage. Safety should also be important while conducting demolition of existing structures.

Purpose of the study is to have a closer look on construction workers safety, the role of design and supervision for safe construction, importance of quality material for construction safety, importance of workmanship & construction safety and impact of construction in the environment and public safety.

Data collection from primary sources with structured and open ended questions made. Analysis conducted mainly qualitatively. Closed ended questionnaires opinions used by likert scale method.

Findings of the research indicate that the major consequenses in not meeting construction safety standards are material loss, loss of human life, harm to the public and environment which arise from use of poor quality material, lenience in supervision, poor workers safety awareness and poor workmanship.

Recommendation from the result of the paper: all stake holders, clients, contractors, professionals, government need to do in collaboration on construction safety in order to minimize loss of life and material as well as minimize harm to the environment.

Keywords: *Workers safety, Quality material for safety, design & supervision for safety, workmanship for safety, environmental and public safety.*

Acknowledgements

I would like to thank my advisor Dr. Dugassa Mulugeta for his ideas and relentless support with swift responses.

I thank my uncle Tefera Berahe, my brothers Zewdu Mebrat, Belay Mebrat for their encouragement to begin and end this program.

I also want to thank Rekik Teshome for providing materials and ideas in her past paper works. I want to thank Tamrat Birhane, close friend, for the various discussions and encouragement to learn this MBA program and also writing this thesis.

I also want to thank Azeb Lakew, classmate, for her dedication in facilitating communications between instructors and students.

My gratitude is also extended to Dr. Dugassa Mulugeta for his support in my beginning of the program when he was the dean of the school.

Dr. Atsede who arranged training for statistical software program that helped us in doing analysis of our findings.

I thank people and professionals who gave me their free opinions in conducting my survey questionnaires, in sacrificing their time to write recommendations to bring change and point out different directions to improve construction work culture and performance.

Table of Contents

List of Tables

Page

List of Figures

Abbreviations:

BRE: - Building Research Establishment

EPRDF: - Ethiopian People Revolutionary Front

FDRE: - Federal Democratic Republic of Ethiopia

GTP: - Growth and Transformation Plans

NIOSH: - National Institute for Occupational Safety and Health

OSHA: - Occupational Safety and Health Administration

SDS: - Safety Data Sheets

SPSS: - Statistical Package for Social Sciences

1. Introduction

1.1Background of the study

Ethiopia's back history of civil war and unstable governments for centuries makes it one of the poorest countries in the world. A relative political stability since the fall of Derg which was a closed market socialist system and emergence of EPRDF government in the past 2 decades seems to help the country to think of economic growth mainly backed by the construction sector. This helps the country to cope with the rest of the world.

Currently, Addis Ababa city looks like a construction site as a whole. Tower and mobile cranes are erected here and there. Building structures with eucalyptus scaffoldings, earth moving machines like excavators, loaders, dump trucks digging, hauling and loading materials are very common to see. Roads and rail roads are also among major projects in the city. (Vaughan, 2014)

The construction experience is a point of concern for it may have limitations in safety issues. Knowledge, skill and other countries experience and best practices should be inherited to minimize material loss, loss of human life, harm to the environment.

The main focus of this paper is to have closer look and evaluate the situation of construction site practices in terms of attention given for over all safety with limited experience of this industry that is "Safety in grade-1 building contractors".

Safety in construction means doing construction activities with minimum harm to fauna and flora.

1.2 Research Problem

Construction safety in Addis Ababa projects is necessary as the construction is booming and activities are very common. However safety matters do not seem getting sufficient attention. Quite many people are discussing the safety of the buildings, the roads and other infrastructures. Unless projects are done with professional designs the safety of the structure will be at stake. Concerned citizens and some professionals claim that this problems are associated with inappropriate and incomplete design.

The other point is the quality of the overall works. No matter how good design we have if contractors use poor material like cement, sand and reinforcement, the structures will have safety issues. If contractors use high silt sand and less reinforcement bars contrary to the design it will have a detrimental effect on the safety of the structures. The other problem that could be observed in Addis Ababa projects is that people without the necessary experience and skill do the site works and have difficulty in interpreting the design and putting it in the right place with the right procedure.

Human safety at Addis Ababa projects is also another point of concern. Most construction sites use eucalyptus scaffoldings without the required design and spacing. This makes the workers life at risk. And most site workers are not dressed with the proper site kit to minimize safety risks.

Another important point with regard to safety is the environment protection. One of the reasons the environment is being degraded is because of the construction expansion. Infrastructure and urbanization increases the global temperature. Pollution due to the settlement after construction and chemicals being released from factories are also safety concerns. Demolition and disposal from construction sites also affects the environment substantially. (Krigsvoll, 2010)

Safety in construction has many aspects. How safe are our buildings? Roads? How safe is human life involving in the construction site? How safe is the construction for our environment? Are the projects lasting long till their service life? Why are some buildings collapsing while even under construction? Why are roads cracking after one year while they are designed for a 20 year or above service period?

1.3 Research questions

- Degree of safety awareness among grade-1 building contractors?
- How do contractors handle safety of workers at construction site?
- Is workmanship affecting safety of the projects?
- Do contractors use quality materials for safe accomplishments?
- Importance of design and supervision for construction safety?
- Is construction affecting the safety of environment and ecosystem?

1.4 Statement of the Problem

There are many safety concerns in the construction projects. Workers are not protected enough from various risks like falling, soil sliding, body part injury and fatality. Contractors encourage lenience in supervision to quickly complete project. Material quality is not maintained to save cost without realizing its effect on safety. Poor workmanship is exhibited because of assigning not well skilled and experienced workers. The environment is being degraded and the pubic being affected due to vast construction activities without taking measure to minimize harm.

1.5 Objective of the study:

General objective:

The general objective is to assess and reach to a conclusion weather or not grade-1 building contractors in Addis Ababa are conducting construction with the required safety standard.

Specific objective:

- To assess contractors regarding workers safety
- To evaluate awareness of contractors about the importance of design and supervision for safety.
- To check the contractors commitment to use quality material
- To find out the skilled and experienced workers assignment in the sites
- To check contractors whether or not they are conscious about the environment and the public safety.

1.6 Significance of the study:

This paper, about construction safety among grade one contractors will have importance in many aspects. It can create awareness for contractors involved in this industry. The document could contribute to minimize gap in construction safety. It could also be used as a stepping stone for further academic researchers or for upcoming young graduate students. It may also contribute for a better quality infrastructure. It will contribute in promoting environmental protection awareness. It can also help to minimize human injury and loss of life in the construction sites.

1.7 Scope of the Study:

Construction industry is so vast that the study will be focusing only on grade one contractors involved in building infrastructures in Addis Ababa city. It will not see safety in other construction projects like road projects, dam projects, irrigation projects, and airport construction projects. The study will also take typical representative contractors as a sample.

Construction safety is so diverse that it will be unrealistic to cover it in one research paper. Among the various aspects of safety: human safety, environmental safety, equipment usage safety like cranes, electric safety, and chemical usage safety in construction sites.

1.8 Limitation of the Study:

The paper has been conducted with other personal work and social commitments. So time constraint was restraining factor. Access to collect data from different organizations was also difficult. Our culture of secrecy and lack of transparency makes doing research and fact finding not that easy. Some of them are just cautious to give any kind of information about the projects. Some try to give responses but with not enough attention. This will affect the quality of the data that is to be analyzed. To get full responses from the scientific sampling is practically difficult. Data, taken and analyzed was only from the possible number of responses. That is the only option to proceed to do this academic paper. Because of the above factors the degree of accuracy of results and conclusions may need further study.

2- Literature Review

2.1 Introduction

What is Safety? Safety in general means to identify and become aware of possible hazards that can be preventable before they happen. Risk of human life, loss of property, the environment including fauna, flora and biodiversity are among the things exposed for risks and concern of safety (NIOSH, 2016).

Construction Safety: Construction work is a dangerous job. Some construction site jobs include: building houses, roads, workplaces and repair and maintain infrastructures. This work includes many hazardous task and conditions such as working with height, excavation, noise, dust, power tools and equipment. Construction work has been increasing in developing and undeveloped countries over the past few years. With an increase in this type of work occupational fatalities have increased. Occupational fatalities are individuals that pass away while on the job or performing work related tasks. Within the field of construction it is important to have safe construction sites (NIOSH, 2016).

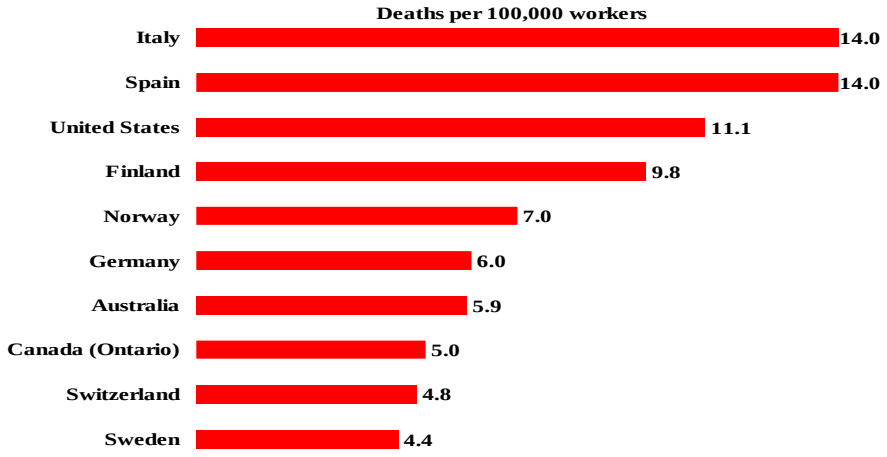

Figure -2.1 Rate of deaths from injuries in construction, selected countries, 2005

Source: The construction chart book. The U.S. Construction Industry and Its Workers (Mcgarvey, 2013)

2.2 Construction in Ethiopia

Ethiopia is a nation with ancient history. Ethiopian architecture continued to expand from the Aksumite style, but also incorporating new traditions with the expansion of the Ethiopian state. Aksumite architecture and influences and its monolithic tradition persisted, with its influence strongest in the early medieval (Late Aksumite) and Zagwe periods (when the churches of Lalibela were carved) (Keys, 2016).

Castles were built especially beginning with the reign of Sarsa Dengel around the Lake Tana region, and subsequent Emperors maintained the tradition, eventually resulting in the creation of the Fasil Ghebbi (royal enclosure of castles) in the newly founded capital (1635), Gondar (Keys, 2016).

Ethiopia is Africa's second most populous country and occupies a highly sensitive geopolitical position, and its economic performance does indeed deserve attention. The country has made spectacular leaps on multiple development fronts in recent years (Arkebe, 2015).

The construction sector has contributed significant role in economic growth of Ethiopia. Ethiopia has launched growth and transformation plans in every 5 years segment. Mega projects of dam construction, road construction, rail road projects and urban development infrastructures are being implemented.

The first Growth and Transformation Plan (GTPI) culminated with registering remarkable achievements in real GDP growth, infrastructure development, social development and capacity building at all levels. During the implementation period of GTP I, public participation and common development spirit and sense of ownership has been stimulated on key national development issues. The achievements of the development Plan at all levels through community mobilization

have set the foundation for economic transformation and the country's Renaissance journey (Commission, 2016).

2.3 Construction Safety in Ethiopia

In light of the fact that Ethiopia has chosen the construction sector as its main driving force of development, significant portion of its annual budget is being pumped in this sector, so many construction projects; dams, roads, railroads are being built. No one denies that modern construction is new practice to Ethiopia. Lack of experience, knowledge and expertise will be the big challenge to meet the required aspiration of the nation. Safety should be major concern to minimize wastage, protect environmental from degradation and the public safety. Since Ethiopia has relatively low experience for construction the cost of learning could be high. The country's budget comes partly from foreign loans and proper use of this financial resource will support nation's capacity to pay its debts. Safe construction will contribute developmental programs and in order projects to become successful.

2.4 Theoretical back ground

Hazards in Construction Sites:

According to OSHA (Occupational Safety and Health Administration), 2005, potential hazards for workers in construction include:

- Falls (from heights);
- Trench collapse;
- Scaffold collapse;
- Electric shock and arc flash/arc blast;
- Failure to use proper personal protective equipment; and
- Repetitive motion injuries (OSHA, 2005).

Safety policies

Safe and healthy working conditions do not happen by chance. Employers need to have a written safety policy for their enterprise setting out the safety and health standards which it is their objective to achieve. The policy should name the senior executive who is responsible for seeing that the standards are achieved, and who has authority to allocate responsibilities to management and supervisors at all levels and to see they are carried out (Office, 1995).

The safety policy should deal with arrangements for training at all levels. Particular attention needs to be given to key workers such as scaffolders and crane operators whose mistakes can be especially dangerous to other workers. Safe methods or systems of work for hazardous operations, the workers carrying out these operations should be involved in their preparation.

Duties and responsibilities of supervisors and key workers should be clearly stated and directives should be issued, arrangements should be known by which information on safety and health is to be conducted. Safety committees will be set up to analyze and plan safety issues. Selection and control of subcontractors will be made carefully to insure safety (Office, 1995).

Training & awareness for workers:

Training on construction workers is a wide-ranging and far-reaching system project. More preparation may quicken the speed in doing work. The investment that subcontracting enterprises put in security training is far smaller than the losses the accident cost. Enterprises should form a comprehensive training system from top to bottom and set up an authoritative professional training institution, also seriously take the personnel training into consideration (Fengshou, 2016)**.**

When they make the long-term, systematic safety education and training plans, construction enterprises must first determine their security goals and targets, purposes of the training and the results to be achieved, in order to ensure the efficient functioning of safety education and training

system. At the same time, quality training on construction workers should develop diverse forms of training and targeted training content in relation to their age, educational and technical level (Fengshou, 2016).

Training system should be designed to conform to the trend of the times and to reflect characteristics of construction industry, as well as to reflect the latest industry achievements. What's more, training system should highlight the personality and the actual needs of workers with practical and easily operation, which fully embodies the timeliness and pertinence of the training system. In addition, industry authorities and local governments also need to take advantage of industry management to actively provide policy support (Fengshou, 2016).

Safety kits:

Where adequate protection against the risk of accident or injury to health, including exposure to adverse conditions, cannot be ensured by other means, suitable personal protective equipment and protective clothing, having regard to the type of work and risks should be provided and maintained by the employer, without cost to the workers, as may be prescribed by national laws or regulations (Labor, 2017).

Workers should be required to make proper use of and to take good care of the personal protective equipment and protective clothing provided for their use.

Workers should be instructed in the use of personal protective equipment and protective clothing (Labor, 2017).

Workers working alone on construction sites in confined spaces, enclosed premises or in remote or inaccessible places should be provided with an appropriate alarm and the means of rapidly summoning assistance in an emergency (Labor, 2017).

Safety helmets: or hard hats to protect the head from injury due to falling or flying objects, or due to striking against objects or structures" (Labor, 2017).

Eye & face protection: Many eye injuries occur as a result of flying material, dust or radiation

Some of these hazards can be removed permanently by proper machine guarding, exhaust ventilation or work design. For many hazards, for example, stone cutting or dressing, personal eye protection (goggles, safety glasses or shields) is the only practical solution (Labor, 2017).

Safety Shoes: The type of safety shoes or boots to be used will depend on the nature of the work (e.g.the presence of ground water on construction sites),but all safety foot wear should have an impenetrable sole and uppers with a steel toe-cap (Ibid 2017).

Table 2.1 Hazard Assessment

Hazard Assessment		
Hazard type	**Examples of Hazard**	**Common Related Tasks**
Impact	Flying objects such as large chips, fragments, particles, sand, and dirt.	Chipping, grinding, machining, masonry work, wood working, sawing, drilling, chiseling, powered fastening, riveting, and sanding.
Heat	Anything emitting extreme heat.	Furnace operations, pouring, casting, hot dipping, and welding.
Chemicals	Splash, fumes, vapors, and irritating mists.	Acid and chemical handling, degreasing, plating.
Dust	Harmful Dust.	Woodworking, buffing, and general dusty conditions.
Optical Radiation	Radiant energy, glare, and intense light	Welding, torch-cutting, brazing, soldering, and laser work.

Source: United States Department of Labor

Hand protection: Hands are extremely vulnerable to accidental injury, and in construction more injuries are caused to hands and wrists than to any other part of the body. Open wounds, abrasions, fractures, dislocations, strains, amputations and burns occur.

Gloves are one of the cheapest and most obvious items, yet they can serve an important function. Nevertheless, many workers are not supplied with gloves so they have to work with their bare hands (Labor, 2017).

Insurance for workers:

Occupational safety and health research and surveillance are essential for the prevention and control of injuries, illnesses and hazards that arise from the workplace. Research and surveillance can fill gaps in knowledge about where hazards exist and what interventions are effective at preventing workplace injuries, illnesses and fatalities. Workers' compensation insurance records are a resource used for these primary prevention purposes. In addition, workers' compensation records may be used for early detection of health outcomes in populations of workers which is part of secondary prevention. They may also be used to help identify effective medical treatment which is part of tertiary prevention (Utterback, 2015).

First aid at site:

Records of injuries, illnesses, 'near miss' incidents and other information that has already been obtained to assist in controlling risks at the workplace will be useful to make appropriate decisions about first aid (Practice, 2015).

Safety data sheets (SDS) should be checked any hazardous chemicals that are handled, used or stored at workplace.

The distance of the workplace from ambulance services, hospital and medical centers should be taken into account when determining your first aid requirements. For example, if life-threatening injuries or illnesses could occur and timely access to emergency services cannot be assured, a person trained in more advanced first aid techniques (such as the provision of oxygen) will be needed (Practice, 2015).

Safety Officer:

A safety officer monitors workplace activities to ensure that workers comply with company policies and government safety regulations. The duties of this job vary by employer, but safety officers typically have responsibilities pertaining to policy development, safety inspections, safety training and compliance with the federal Occupational Safety & Health Administration, commonly known as OSHA. Some safety officers, such as those in the construction industry, must have several years of field experience to qualify for this type of job (Morgan, 2010).

2.5 Duties of Responsible Persons:

The Real Estate Developers Association of Hong Kong and the Hong Kong Construction Association hand book clarifies that, a successful corporate safety programme should include a clear statement of policy by the client or owner, expressly showing management support for meeting safety objectives and the envolvement of different stakeholders in the management system (Construction-Association, 2005).

Clients:

Clients should put safety and health on the top of the agenda along with financial considerations. To ensure that all contracts are completed on time, on budget and safely, clients should ensure that safety and health is not compromised. During the design stage safety and health considerations must be put in place. The clients should also allow sufficient time and resources for implementing the contractor's safety programme (Ibid 2005).

Contractors:

Contractors should plan for emergency routes and exits, traffic routes, danger areas, loading bays, ramps, etc. they must also ensure provision of safe work equipment, with due care to their suitability, selection. Safety features, training, information, inspection and maintenance are also

necessary. Excavators need safe working slopes. To prevent roll-over or overturn design and anchor fork-lift trucks and dump trucks are required. Contractors should also provide suitable safety signs and warning notices. Personal protective equipment, e.g. reflective clothing that should be fit, comfortable and well maintained. Workplace should be free from hazards and suitable communication and information will let employees know how to protect themselves against hazards. Conducting regular jobsite safety inspections and assign trained first aid personnel on site and/or put in place an emergency response system (Ibid 2005).

Employees: Employees follow all safety rules, ensure that all safety features and equipment installed are functioning properly. They must replace damaged or dull hand tools immediately. Avoid horseplay or other activities that create a hazard. If they are not well or physically not fit to do the job they must not involve in working. Workers should report any unsafe work practice and any injury or accident to the line supervisor.

Senior site management: Inform workers of the risks present and the control measures required. Evaluate risks that cannot be avoided and combat risks at source. Establish emergency procedures by ensuring appropriate training is given to avoid all risks to workers.

Architects, structural engineers, and other designers

Architects, structural engineers, and other designers should discuss and agree the safety and health terms with client. They will also plan for safety and health in layout and design drawings, with due regard to buildability, future maintenance and repairs. They must provide information about the safety and health risk of the design after the client has decided on which contractor(s) to use. Periodic checks and sort out interface problems with different contractors and certify contractor's claims for safety payment and conclude the final accounts (Construction-Association, 2005).

Safety professionals and supervisors

Safety professionals and supervisors identify hazards in the workplace by giving advice and suggesting options for solving safety or health problems. They also suggest different kinds of help available, such as specialists in chemical, electrical and mechanical engineering safety to sort out issues at stake. Accidents/incidents remedial measures should be investigated for recommendation. Periodic checks are carried out and report provided by summarizing the findings.

In addition, effective safety and health programs are important, for example training employees (Construction-Association, 2005).

2.6 Safe design in construction

According to Behm, (2011), influences on the eventual safety and health outcomes during a construction project are multifaceted and vast. The design of a construction project can have an influence on the safety and health of workers involved throughout the project's life cycle including during construction, operation, maintenance, refurbishment, and decommissioning. In recent years design has become a focal point of researchers and regulators.

According to Fadier, at one time it was the job of an engineer simply to make things work. However, to achieve better safety throughout product lifecycles, or in construction and, more specifically, the built environment and its lifecycle, it is recognized that the role is a much bigger. How the abilities of engineers can be harnessed to this effect raises a number of questions such as the conceptualization of design, the possibilities for integration of safety in design, the prediction of human actions downstream of design decisions and design methods. These questions tackle the concepts that underpin the work of engineers and their response. Their way of thinking really is key to whether the benefits that those in the occupational health and safety arena envisage can actually be delivered and by what means (Behm, 2011).

What is Safety by Design?

- The process of considering construction site safety and health in the design of a project
- Designing for safety constructability

Prevention through design

"Addressing occupational safety and health needs in the design process to prevent or minimize the work-related hazards and risks associated with the construction, manufacture, use, maintenance, and disposal of facilities, materials, and equipment." (NIOSH, 2016)

According to American Society of Civil Engineers' Code of Ethics:

Engineers shall recognize that the lives, safety, health and welfare of the general public are dependent upon engineering decisions

Considering Safety During Design Offers the Most Payoff

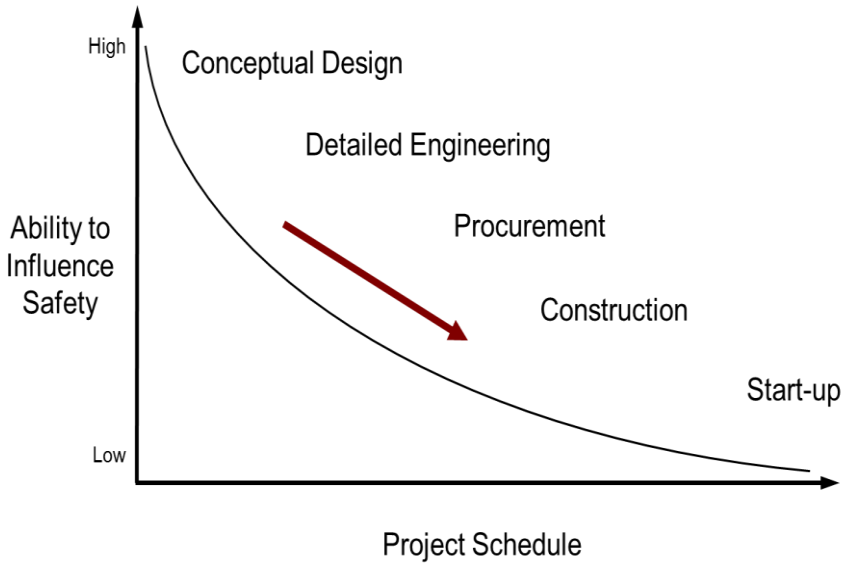

Figure 2.2 Project Schedule

Source: safety by design Mike Toole (PhD)

Benefits of Safety by Design

- Reduced site hazards → fewer injuries and fatalities
- Reduced workers compensation premiums
- Increased productivity
- Fewer delays due to accidents during construction allow continued focus on quality
- Encourages designer-constructor collaboration (Toole, 2014)

2.7 Workmanship & Construction Safety:

Many defects in construction projects are due to human error. In other words, we can say that human error happened due to poor performance in workmanship during construction of a building. Poor workmanship in housing construction, and poor management and control of building contractors have contributed to the housing problem. According to research conducted by the Building Research Establishment (BRE), 90% of building failures are due to problems arising in the design and construction stages. These problems include poor communication, inadequate information or failure to check information, inadequate checks and controls, lack of technical expertise and skills, and inadequate feedback leading to recurring errors. The quality issues of low cost housing nowadays begin to arise as there are many complaints about defects in some of the building elements of the house. One of the causes of this condition is due to poor quality of workmanship during construction. This will affect the quality of life of occupants and also giving bad image of the parties involved in the construction of low cost housing. (Othman, 2014)

The future effectiveness of the construction industry depends on the quality of the workforce it educates and trains. This requires strong commitment from construction firms and the government to maintain requisite training levels (Greenwood, 2003).

Appropriate training can only be developed if training needs are carefully identified.

This requires interested parties in the industry to understand and anticipate the skills need of their workforce. This can only be achieved if they are in possession of detailed information on the availability of labour resources in the industry. Such information includes the skills needed by professional and technical staff in both the public and private sector, elected local authority members and members of local strategic partnerships. The gaps and shortcomings in skills and capacity to be improved and filled in the future (Greenwood, 2003).

Develop mechanisms for sharing knowledge, good practice and experience of ways in which these skills can be provided across the country, and develop new approaches (Greenwood, 2003).

Engineering contractors encounter serious challenges in order to sustain their businesses, especially in a weak economic climate. A certain level of construction experience, expertise and training are required to manage a sustainable construction company (Allopi, 2014).

Construction is where designs are put into practice and the owner starts paying. No matter how good the design is, it is only as good as what the construction stage of the processes makes it. In construction and engineering projects the nature and type of defects vary drastically, as at the point at which they become apparent; at one end of the scale minor defect can easily be corrected before the building is handed over to the client, while at the other extreme, significant defects may occur long after the original work has been completed and require extensive remedial works to fix (Femi, 2014).

Faulty construction is a problem for people working on a building, as well as for people who will enter the building after it is completed. When safety and building code are not followed, the result is an unsafe structure that can pose many dangers.

Faulty construction practice cause massive loss of resources, there are many defects in construction that can be categorized under faulty construction practices, and any of this can lead to serious

issues throughout the life of the building while contractor licensing and building code seek to eliminate faulty construction practice, it's not always possible to detect problems immediately, or ever, if the event that reveal the fault never transpire; Al-Hammadet. al. (1997) maintains that, provision of adequate structural design, hiring of qualified architects and building systems design professionals, and provision of sufficient details in construction drawings are some of the measures that could be employed to improve building maintenance (Femi, 2014).

It is very common to see a higher incidence of faulty construction practice during period of very fast construction, inspectors are overworked, and building authorities are under constant pressure to issue permits and move the workload through their office. Faulty construction practice may not be intentional. It could be a design flaw that the architect didn't detect before passing down the blueprint for construction. Element of the design might not have been carried out precisely as depicted on the blueprint (Femi, 2014).

A construction worker may accidentally assemble something wrongly. There may be undetectable flaw in the materials used. Inexperience, such as may be the case when clients choose to do their own construction which is a common practice this may lead to faulty construction. (Femi, 2014)

2.8 Quality Material for safety:

Formworks (Temporary Structures)

Definition:

Any means or methods which provide temporary support, access, enhancement, or otherwise facilitate the construction of permanent structures (Nemati, 2007).

Necessity:Temporary structures form the interface between design and construction. Most permanent structures simply could not be built without temporary structures.

Impact on Schedule, Cost, and Quality

Losses in time and money will occur if the temporary structures are not planned and coordinated with the same degree of thoroughness as the permanent structures (Nemati, 2007).

Safety

Failure of temporary structures have been responsible for hundreds of deaths on construction sites. Safety should be the overriding priority of contractors and designers responsible for implementing temporary structures (Nemati, 2007).

Responsibility

The norm in the construction industry is to place the responsibility for temporary structures solely on the general contractor. However, architects and engineers must at least have formulated their own method of construction. Coordinating the design of permanent structure with the temporary structures that will be required can lead to more efficient and cost effective construction (Nemati, 2007).

Laboratory for quality:

Designers and builders of construction projects no longer can consider quality control testing an option or convenience. In the past decade, testing for the quality of materials and finished construction has become a necessity that no responsible builder can neglect (Kishore, 2015). The truth of this statement is proved not only by construction delays and cost overruns but also by catastrophic failures of major structures. Such catastrophies include dam failures, collapses and foundation breakdowns in multi-storeyed office and apartment structures; and other failures in stadia, factories, schools, auditoria, public buildings and bridges (Kishore, 2015).

Each construction project determines its own individualized testing needs. A variety of factors influence the type of testing required. Among these factors are size of the structures, terrain, type

of soil and subsurface conditions at the construction site and other conditions peculiar to the specific location. The expertise of the construction engineers and technical personnel working on the project will also have an influence on the testing and inspection need. Testing facilities may range from a simple, inexpensive test kit carried in a portable chest to a fully equipped Central Testing Laboratory (Kishore, 2015).

Purchasing quality material:

Construction organizations are not proficient at identifying the capabilities of their suppliers and sometimes rationalize decisions for the selection of materials suppliers based on convenience. This integral function—materials supplier selection process—should be integrated into the supply chain management environment so that the availability of bulk materials is ensured (Benton, 2010).

The mistakes made by many organizations in supplier selection can be avoided with three factors for success. Prime contractors should assess the core competencies and capabilities of each supplier and then ask if that supplier could be replaced. Since firms exit the market for various reasons, prime contractors should be prepared to establish alternative partnerships.

Lastly, the prime contractor should share information with all team members and request their input (Benton, 2010).

2.9 Other countries case history

The Bad Die Young

(The case of Zhejiang Province)

Corner-cutting, low industry standards and shoddy materials have turned the products of China's rampant construction boom into ticking time bombs

While reading through the local newspaper of his hometown of Ningbo, Zhejiang Province, 83-year-old Chen Zhaoyuan was not surprised to spot a headline announcing the collapse of a five-story residential building constructed 20 years ago, resulting in one fatality and six injuries

In 2009, 17 residents were killed in Shijiazhuang, Hebei Province when their compound collapsed. Ningbo, Chen Zhaoyuan's home town, has been particularly unfortunate, with three collapses that same year, all buildings constructed within the last two decades (Qian Wei, 2014).

Performance of Buildings in Haiti Earthquake

Construction materials used in Haiti are of significantly poor quality. The concrete tends to be low strength due to insufficient amounts of cement, high water content, and the use of weak aggregates. Concrete masonry units similarly lack sufficient cement content, as well as poor quality aggregates. Hydrating of concrete or concrete masonry units is not a common practice. The use of smooth reinforcement in new construction didn't cease until approximately 2000, compared with the deformed steel bars that are critical for adequate composite performance of reinforced concrete. The lack of adequate seismic detailing is pervasive in Haiti. Use of undersized and insufficient amounts of longitudinal reinforcement is very common in most columns, typically with a longitudinal reinforcement ratio of 0.4-0.8 percent. In addition, transverse reinforcement was frequently inadequate in size and spacing, and at times omitted altogether (Council, 2010).

'Poor quality construction materials to blame' for deadly Bangladesh factory collapse

A government investigation has found poor quality construction materials and building code violations were among the "series of irregularities" that caused the collapse of a building housing garment factories in Bangladesh.

The disaster killed more than 1,000 workers and highlighted the hazardous working conditions in **Bangladesh's** $20 billion garment industry and the lack of safety for millions of workers who are paid as low as $38 a month (Malkin, 2013).

"The owner used extremely poor quality of iron rods and cement," committee head Khandker Mainuddin Ahmed said after submitting its report to the government. "There were a series of irregularities."

The report also found that building owner Sohel Rana had permission to build a six-story structure and added two floors illegally so he could rent them out to garment factories. Past statements from authorities said the owner had permission for a five-story structure and added three floors illegally (Malkin, 2013).

2.10 Environment & Public Safety:

Construction & the ecosystem

Environmental deterioration has captured the world's attention and has been one of the most discussed subjects locally, nationally and globally (Bentivegna et al., 2002). Langston and Ding (2001) posited that the world is in crucial environmental catastrophe. The increase in population and the quest for development such as the built environment has resulted to ozone layer depletion, global warming, resource depletion and ecosystem destruction. This has put the built environment and the construction industry under the spotlight since its activities significantly impact on the environment (Ametepey, 2015).

Construction activities affect the environment throughout the life cycle of development. These impacts occur from initial work on-site through the construction period, operational period and to the final demolition when a building comes to an end of its life. Even though the construction

period is comparatively shorter in relation to the other stages of a building's life, it has diverse significant effects on the environment. For that matter, there is progressively growing concern about the impact of construction activities on human and environmental health. Even though, construction project development potentially contributes to the economic and social development, and enhancing both the standard of living and the quality of life, it is also associated with deterioration of the environment (Ametepey, 2015).

Construction & the public safety:

Construction often generates community noise/vibration complaints despite the limited time frame over which it takes place. Complaints typically arise from interference with people's activities, especially when the community has no clear understanding of the extent or duration of the construction. Misunderstandings can arise when the contractor is considered to be insensitive by the community even though he believes he is in compliance with local ordinances. This situation underscores the need for early identification and assessment of potential problem areas

(Mervyn Jones, 2001).

Public Impacts experienced during construction

Most projects are very different from one another, the main concerns reported by the local communities are very similar. The common impacts experienced during construction are noise from machinery, increased traffic and congestion because roads may be blocked and travelers stranded. Dust particularly from demolition activity, sandblasting, mud from the site affect streets, pavements homes and shops. Parking disruption happen because of workmen, site vehicles, and site visitors. The other thing is increased traffic and congestion caused by deliveries, site traffic, and workmen's vehicles (Mervyn Jones, 2001).

Restriction of access to homes, shops and streets is also a common problem. Safety risks from holes in pavements, difficult road crossings, and falling materials create so much inconvenience to the public. Health impacts from dust and pollution as well as psychological effects such as stress can also affect the quality of life of the surrounding. Poor behavior of workmen in terms of lack of consideration and rudeness and sometimes extended interests and affairs to the community could bring unexpected situations (Mervyn Jones, 2001).

Post Construction Impacts:

Parking problems for residents and local businesses is among the effect of construction aftermath. Reduced access to bus stops, shopping and crossings affect all but specially the elderly and the disabled. An increase in traffic because of expansion brings new facilities that create more and more mobility and businesses. On the contrary a loss of facilities for the community like open field for playing used by children or domestic animals circulation will be limited. An increase in noise and disturbance generated by the new development and businesses, an increase in crime due to changes in the local area and new comers can also be manifested. The obstruction of views, the final plans or development usage being different from what was expected are also other aspects of unrequired outcomes (Mervyn Jones, 2001).

Sustainable Construction (also known as green construction or sustainable building) refers to a structure, the construction process and occupancy processes that are environmentally responsible and resource efficient throughout a building's life-cycle from location to design, construction, operation, maintenance, renovation, and demolition.

Sustainable Construction is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Krigsvoll, 2010).

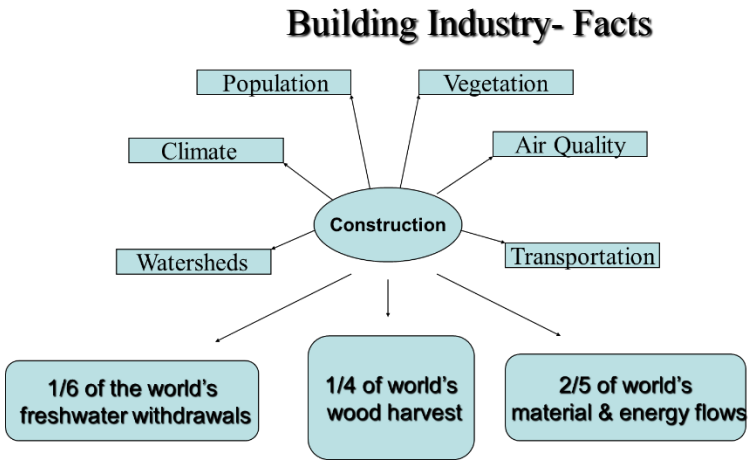

Figure 2.3 Building Industrial facts

Source: (Krigsvoll, 2010)

Sustainable construction will enhance living & working conditions as well as leisure environments for individuals & communities. It consumes minimum energy over the life cycle to avoid wastage and minimise pollution. Integration with the natural environment will help to do more with less by using renewable resources as much as possible (Krigsvoll, 2010).

Applications of sustainability in construction:

At pre-design stage: enough attention should be given to select material, forecast the budget to complete the project. Have a profound project schedule to determine the time line. Also need to know and align with laws, codes and standards. Make studies about the surrounding area to make the right selection of site.

Site selection: Site analysis and assessment will help to understand the nature of the landscape, material type and depth. Create access, develop the site and make layouts before starting the main excavations and building. Plan how to manage surface and subsurface water to conserve it as well

as to avoid water obstruction for the construction activities. Allocate the required site material and necessary equipments **(**Ibid, 2010).

Design stage: Make sure to select the right kind materials and specifications, light and indoor air circulation needs to be considered.

During Construction: State of the art consciousness for construction is the one that is environmentally friendly. Preserve the vegetation, wild life and the depletion of resources like river and soil.

Operation and Maintenance: Once the infrastructure is built in the place it will ready for operation and giving function. There has to be a plan for maintenance to ensure indoor air quality, energy efficient or any resource efficient building system. Renovation in some periods will reinstate in to its original state and elongates the life of the structure even longer. Housekeeping, gardening and custodial practices should also be made to minimize cost of maintenance and renovation (Ibid, 2010).

Construction and Demolition

Waste building materials or dredging materials that are produced in the process of construction, remodeling, repair or demolition of residential or commercial buildings. It may also come from other structures or pavements. Construction waste and demolitions consists of concrete, bricks, timber, sanitary ware, glasses, steel and plastic (Mötzl, 2011).

To reduce waste: ensure materials are ordered as per the required quantity to prevent over supply to site. Minimize the creation of excessive scarp waste accumulation on site so that unnecessary waste will not inhibit construction activities. Correct storage and handling of construction materials will minimize waste generation due to damaged or spoiled materials. The other point is

to keep work precedence and sequence of operations and assigning the right person for the right duty to reduce rework and wastage coming afterwards (Mötzl, 2011).

Construction waste recycling: When considering recyclable materials three major areas need to be taken in to account. First it has to be economical, second it should be compatible with other materials and the other point is the property of the material.

Construction waste reusing: Reuse bricks, stones, slabs, conduits, piping railings to the extent possible depending up on their condition. Other materials like plastics, broken glasses and steel can be recycled through factories for reusing. Rubbles, brick bats and broken concrete pieces cab be used for various building activities such as leveling undercoat of lanes where the traffic does not constitute of having heavy moving loads. Fine materials like sand and dust can be used as cover material for sanitary land fill. Excavated soil can be used to developing landscape for the construction of embankments in civil engineering projects (Ibid, 2011).

3. Methodology

Area of focus or sampling is grade-1 contractors located in Addis Ababa. Grade-1 contractors can be building contractors, road contractors and general contractors. These contractors have license provided from construction minister. The type and the grade is determined by the requirements set by the ministry.

This paper will use different ways like observation and own experience, open ended questions, closed ended questions to assess and gather important information for later interpretation and analysis of the study.

Research design

Case study of multiple construction sites used.

Explanatory case studies aim to answer 'how' or 'why' questions with little control on behalf of researcher over occurrence of events.

Exploratory case studies aim to find answers to the questions of 'what' or 'who'. Exploratory case study data collection method accompanied by additional data collection method(s) such as interviews and questionnaires.

3.1 Data collection:

Observation:

This papers report has incorporated ideas and experience gained through own observation. The background of the researcher being in the construction filled has helped to appreciate the critical issues and keep in memory the hazards, human and material costs of unsafe

construction cultures. So this paper has included experience and own observation of the past and current to enrich this papers required data & information.

Interviews:

Interviews were made to respondents to get their outlook about the safety concerns of the ongoing massive construction activities. Interviews were made by give respondents plenty of time to fill the structured and unstructured questionnaires Most of the respondents were in the middle of hectic construction activity. Hence the researcher tried grasp their attention and cooperation for the responses

Structured Questionnaires:

A list of variety of questions were used in each category. The emphasis was in obtaining answers to carefully phrased questions. The advantage of such interviews is that the outcome is easily administered and the data is easily manipulated. The disadvantage is its rigidity.

Likert scale oppinion questionairs were used. Likert scales are survey questions that offer a range of answer options — from one extreme attitude to another, like “extremely likely” to “not at all likely.” Typically, they include a moderate or neutral midpoint. (survey-monkey)

Five groups of Likert Scale type questionnaires were used summing up 44 questions to be answered by respondents. This was chosen to encourage respondents to answer such types of questions for their simplicity. Moreover it is convenient to make the analysis and interpret the data.

Open ended questionnaires:

The researcher chose this so that dialogue between interviewer and interviewee can be conducted. Unlike closed ended questionnaires it is not rigid and also it is a desirable strategy for qualitative data collection. It also helps the respondent to focus in his/her perspective. Elicit rich and detailed data can be obtained from this approach. Individuals or small groups can conduct this type of question and answer. The best way of doing it is face to face otherwise telephone or email communication can also be used effectively.

3.2 Statistical Tools Used

- Frequency tables
- Ratios
- Central tendency like mean, mode, median, standard deviation could be used

Analyzing quantitative data:

Quantitative data can be nominal, ordinal, interval & ratio levels of measurement. Depending on the nature of obtained data it will be classified in the above categories.

Analyzing qualitative data

Common techniques used:

Phenomenological is analyzing and reporting incidents as observed. Incidents or phenomena are attempted to be written with the right emotional and authentic manner.

Ethnographic is studding people or situations with in their own environment through the use of methods such as participant observation face to face interviewing.

Narrative & discourse is storytelling, field notes, and letters as the units of analysis to research and understand the way people create meaning in their lives.

Constant comparative method is a process in which any newly collected data is compared with previous data that was collected in one or more earlier studies.

Sampling:

Purposive sampling used with multiple cases. Sampling represents **a** group of different non-probability sampling techniques**.** Also known as judgmental**,** selective or subjective sampling, the sampling relies on the judgment of the researcher when it comes to selecting the construction sites.

Table 3.1 sampling table from population

Required Sample Size†

Population Size	Confidence = 95% Margin of Error				Confidence = 99% Margin of Error			
	5.0%	3.5%	2.5%	1.0%	5.0%	3.5%	2.5%	1.0%
10	10	10	10	10	10	10	10	10
20	19	20	20	20	19	20	20	20
30	28	29	29	30	29	29	30	30
50	44	47	48	50	47	48	49	50
75	63	69	72	74	67	71	73	75
100	80	89	94	99	87	93	96	99
150	108	126	137	148	122	135	142	149
200	132	160	177	196	154	174	186	198
250	152	190	215	244	182	211	229	246
300	169	217	251	291	207	246	270	295

According to source of ministry of construction, there are 133 registered grade one contractors. How many of them are engaged in Addis Ababa city is not clearly known. Theoretically the sample size would be from statistical tables around 100. However due to various limitations and factors only 44 respondents participated.

Ethical Consideration: Since this paper is for academic purpose the researcher has taken maximum care to keep the privacy of information of respondents by not mentioning their name or identity in any form. This was told to respondents while collecting data from them. This helped respondents to feel free to provide their opinions for open ended and structured type questionnaires. Even though some of respondents exhibit reluctance and suspicion of such kind of studies. Some refused to return paper by giving different reasons. Our traditions secrecy and lack of cooperation contributes for such obstacles for any researcher on duty.

4. Data Analysis, Results and Discussion

4.1 Safety Awareness by Observation

Overall workers safety:

In any construction activities the safety of the workers is important. Because any activity costing too much of human life will have consequences on the future productivity. The researcher's observation in Addis Ababa city construction activities regarding workers safety is worth attention. The construction sites do not seem safe to workers in the site. The selected areas where high construction activities were around Kasanchis, around Bole Medhanialem and Wolo Sefer areas. In these areas there is a wide building construction activities. Other area sites are scattered and inconvenient to conduct research.

Safety kits:

In these places the researcher observed that workers are mostly not wearing safety shoes, clothes, goggle for the eye and helmets. This makes the workers life at stake. In case of exposure to material falling from heights they will be vulnerable for danger. They don't have safety shoes to protect themselves from metals and nails in the ground. Eye goggles will also protect their eyes in case of dust coming from soil or cement affecting their eyes. They are not wearing gloves to protect their hand and fingers while doing construction activities like reinforcement bar bending and carrying. They also use bare hands to carry concrete with metal sheet barrel. Reflective closes also not common. These closes would help them for easy visibility especially when they work in darker places of the building under construction. Most construction sites also lack safety officer to monitor and control workers to wear safety kits.

Unsafe Formworks:

Temporary structure or scaffoldings is where workers do activities from heights. Since most sites use wooden formworks and false works instead of steel material, safety of workers is not guaranteed. Workers fall from heights and get injured or die from such incidents.

Risks in excavation:

During deep excavation, some workers risk their life from soil sliding and falling on to the workers. To do safe activities the sites should have protective and soil stabilizing means. To execute foundation structures and excavation workers need have proper access and means of mobility like strong ladders and stairs. When earth moving excavators involve, workers should have proper training and awareness how to work nearby the machines. Working with proper clearance and minimize accidents from the machine. Make proper ramps for the machines which travel down and up from the underground.

Water & sanitation: for workers to perform well in the site they should be provided with enough water and toilets. But in many construction sites these facilities are not available in sufficient. Workers also need cafeteria and places of rest when they are off work. During lunch time or during sickness and accidents. When there is heavy rain sometimes workers suffer from getting shelter for that time.

First aid and health officer: In my observation most construction sites do not have stand by health officer to help sick workers or workers injured in the site. First aid facility is also important. Some of the construction sites told me that they use nearby clinics for such incidents. But this kind of service would not be preferred because it can be time consuming

and some accidents do not give time. Loss of human life may happen before arriving this health centers.

Insurance for workers: Many sites are not committed to provide insurance for workers. Some of have workers insurance. This makes the life of workers at risk. Their future security will also be not fine. Government should also have policies and implement to make sure every construction site to have insurance for the workers. This protects their security and even makes family of the workers safe. It helps also for good psychology of the workers.

Training for workers: Unless site workers are aware of risks they will not take care much. So there needs to be periodic training and awareness sessions. In my observation this things are not taken seriously. The occurrences are rare and the culture for making aware the construction workers is low. The survey data is also showing this result. There should also be a training manual for safety. Safety officer guidance to teach and control site workers.

Records of Incidents: Accidents and bad incidents should also be recorded to take lesson and protect from happening over and over again. My observation with this regard is also not satisfactory. Since in most sites there are no safety officers, records are not properly kept to be used for future lesson. They should also try to learn from other sites for best practices and lessons. Such experience sharing will help projects to learn from other mistakes.

Impact of Design and Supervision for safe construction:

Design & Safety:

For every safe and economical project professional design is the key. If things are not right at the blue print level, they will end up in making our projects unsafe. Respondents agree

with this idea. Some designs in Addis Ababa projects lack completeness and clarity. Some of them are done by unprofessional people. The reinforcements or structure sizes are higher or lower than the required design. This will reduce the safety of the whole building. Some professionals copy some templates or designs and use them for other clients without redesigning to match for the new landscape and soil type. Other consideration like wind load, occupants load, and the nature of the building eventually should be considered.

Professionals availability: Some say there are no enough professionals or companies who make the design. Some others say that even though there are plenty of professionals they are not well experienced. There is also issue of love for the profession and dedication. Some engineers complain about the scale of their service fee for the design they make. This professionals claim that in Ethiopia design fee lower than many other countries. Clients are not aware of the importance of the building design. This seriously discourages professionals from doing heavy projects with most care. That is why the quality of the design is being compromised.

Awareness by clients: As said above the project owners are not well aware of the importance of choosing and assigning skilled and experienced engineers. In the construction sites there are not even enough of them. Some tasks that should be done by professionals are done by low ranking workers, site formans. Sometimes clients do projects with family members or affiliate friends which are not fit for the required place. When professionals are asked they say, clients do not well pay for the professionals because they only focus on material and other expenses and they don't value the importance of input by professionals. This conflicting attitudes by both parties contribute for the poor quality construction projects and failures.

Supervision for safety: Good design will not be enough to make projects safe. Design will be placed correctly if supervision consultants play their part by supervising the ongoing projects. Placing of materials as per the design with the proper number and quantity. With this regard there are concerns in lack of enough number of supervision staff. Availability in the site of the engineer. Sometimes contractors complain of approval to cast concrete reinforcement placing on time. Delay of site instructions and design changes also creates problem to the contractor. Negligence and absence from site of supervision staff may compromise the improper placing of materials. All these things make the project unsafe.

Supervisors' ethical conduct: Some respondents claim there are some supervision staffs demonstrator unethical behavior. There are claims that sometimes expectations of various benefits to approve drawings on time, to sign payments on time. Quality of material and work may be compromised due to this kind of behavior. Contractors suffer to handle such matters and face delay of time.

Laws and regulations: to maintain good design and safety, laws and regulations by government is crucial. Respondents say there is big gap in this regard. Most construction activities are done with scarce follow up by government bodies. Responsibility is left for the supervision company. But government is among the stakeholders to maintain safe and quality projects. Construction permits are provided by sub cities of Addis Ababa. But to check whether or not the projects are being implemented with the approved design should be followed up. In many cases approved design and built design are not the same. So many modifications are made after the approval. This will result in rampant building construction culture and the image of the capital city will be not as good as expected. Addis Ababa is the capital of Africa and it has many international organizations. So the need for quality

and safety to make the city competitive in the world stage is very high. Government has policies and regulations. The problem is implementation. For this purpose government needs to allocate budget and sufficient professionals to assign them to the construction projects to make sure they are being conducted in compliance with the city code.

Material Quality for Safety:

Formwork material: The quality of the formwork material used in construction sites affects the quality of the end structures. Observations indicate in some sites formworks made from steel structure and other most cases plywood material is used. Formworks are usually used over and over again. Steel formworks are very good for reusing because when they are used again and again their shape will not be deformed. But they are also convenient to repair when they are deformed. While wooden formworks do not last long for reusing. Wooden formworks are also not repairable. It is common to see wooden formworks than steel structure in Addis Ababa sites. Scaffoldings and false works are also mostly local eucalyptus material. Reusing of eucalyptus material for other projects is unlikely since eucalyptus scaffoldings easily lack their strength because of the rainfall and sun exposure. This scaffoldings are also not safe for the workers as they are breaking while workers are up there to cast concrete or make welding. Workers falling from heights because scaffoldings break easiy because of loose nailing or due to reusing and aging. I witness some concrete columns beams and slabs deformed or not straight due to the quality of the formworks. In the history of some construction sites a total collapse of the scaffolding was recorded in the past. That puts the life of workers at risk.

Laboratory facilities to check material quality: Building projects in Addis Ababa are high rising and high cost. To secure material quality laboratory facilities needs to be available in most sites. To test quality of concrete, quality of soil and reinforcement bars. But most project site lack this facilities. The consultant sometimes orders them to check quality from other companies which do laboratory tests. The problem with this procedure is that is time consuming and the frequency of going to other companies for lab test is not enough. To save time contractor mostly does works without making lab tests. This will compromise the required quality of materials. The other reason the researcher realized is that laboratory facilities are expensive to purchase for each construction site. This is one of the reasons the contractor is discourage to own them at each site. But some test procedures do not need expensive devices and can be made available at site. Some of the tests are even done manually. The other issue regarding tests is sampling problem. In many cases contractors sampling with great care. It is not similar to the actual practices. Mix ratios are done well, sampling is selective not random. This makes the lab results not reliable because they don't represent the site activities. This will compromise the safety of the projects. To avoid such risks supervisors must be responsible in closely controlling the process. Samples should be taken randomly and must be typical of the site materials. Sampling should be done by supervision staff or representative.

Purchasing of quality material: To make projects safe materials should be purchased that meet the right quality. Cement, reinforcement bars, sand, gravel and other materials are purchased from the market. Many contractors are price sensitive and go to buy

lower or medium quality material. This is common practice which will affect the overall safety of the structures.

Reinforcement bars: there are many kinds of reinforcement bars, local or imported from different countries. So reinforcement bars have different tensile capacity and dimension. The standard and quality is specified in the contract. Some of the reinforcement bars do not meet required tensile strength. Some bars are have dimension thinner than what is written in the specification. Some unethical contractors order manufacturers to reduced diameter of the bars in millimeter and want to get price reduction while the labeling is not changed. This will compromise the quality of the reinforcement bars and make the building unsafe.

Cement: Cement is in Ethiopia a local product unless there is scarcity happens some periods. There are many sources and manufacturers. Quality is controlled by government or private organizations. The problem with cement is the type of the specified cement quality. There are various cement quality standards for the required concrete quality from C5 up to C50. For such different concrete qualities different cement quality is needed. OPC or PPC cement quality. Hence the contractor should be checked to use the specified cement by the consultant.

Soil: To make our structure safe we need quality selected material as per the specification to backfill foundations. Contractors tend to use quarry sources that are not as good as the requirement. Some contractors see the distance and the price of the selected material to save money. Some soil sources are very granular some others are so much clay. These materials will make the foundations not safe and unstable.

Sand: The other critical type of material is sand. Unless contractors get the right type of sand the quality of the concrete and the safety of the entire building will be at stake. Sand can be natural from rivers or made by crushing stones with crusher. The tradition here in Addis Ababa is to use river sand. Sources by distance are so many. Some are 90km up to 130km from Addis. The nearby sand sources are cheaper with poor quality and the sources very far are expensive and good quality. Some contractors compromise quality of sand for price. The researcher observed poor quality sand and high silt in many site visits.

Material safety controller: To insure material quality material controller should be assigned in construction sites. But this practice is not common in many sites. Contractors do not have controller and data sheet to record material quality. Some materials that are expired and spoiled are not replaced and disposed. This will affect other good materials. For all this assignment they don't have material controller which is common in many sites according to our observation.

Workmanship & Construction safety: After a good design and selection of quality of material lack of workmanship plays detrimental role for the safety and completion of the building.

Assigning skilled and experienced workers: The researcher's observation on the ongoing projects of Addis Ababa, workers are assigned for the construction duties. There are some deficiency regarding skill and experience. Number of workers is also sometimes not proportional to the work size. One person is assigned to do multiple responsibilities.

Training & Upgrading: To meet the required workmanship skilled workers need to get different training to coup with new methodologies and ideas. Experience sharing and discussion is also vital. With this regard there are gaps on the construction sites. Training culture is not satisfactory. The other point is rewarding and upgrading to motivate competitive workers. Humans need stimulation and motivation when they do day to day works. Unless good works are rewarded there will be not improvement from time to time. The researcher's observation in this regard is that many workers complain about performance based payments. Whether they perform well or less the salaries are similar. This will affect stimulations of workers and productivity.

Monitoring workers: to minimize wastage and promote safety workers at site must be monitored while they are placing formworks, reinforcements and concrete. Due to negligence and lack of motivations some workers may make the project unsafe. The researcher observed carelessly casted concrete which end up visible segregations of gravel. Poor vibration of concrete results in such errors. Some reinforcements are not placed and anchored very well to maximize strength. Sometimes number of reinforcement bars may be reduced. All these activities may make the structures to be unreliable and unsafe. Observed defects with concrete casting the columns, beams and slab will not have the design strength.

Supporting workers with technological devices: For a better performance and quality workmanship, skilled workers should be supported by technological devices like crane, surveying instruments communication facilities. Our observation with this regard is that most site use elevators made from electric motor and steel structure at site. But this is not reliable for performance and safety. For surveying measurements at site instead

of theodolite or total station traditional tools are used in some sites. This may compromise workmanship quality of the works.

Poor performance: Some workers may do repetitive mistakes at site out of negligence or lack of motivation. As good works should be rewarded, bad performance should also be discouraged. "Carrot and stick" works to reward or punish workers. "Doing the same thing over & over again and expecting different results is insanity" Albert Einstein
So if any worker is doing same mistakes over and over again they should take action by replacing or demotion.

Defective works: When some of the works already executed are found to be defective or contrary to the design or erratic work there has to be action to demolition and rework. Our observation with this regard in the sites is that demolition of defective works is not a common practice. To save time and money erratic works are left the way they are. This makes the building unsafe and compromises its aesthetic value.

Concrete mix ratio and mixing: This activity needs high follow up. Water-cement-sand-gravel ratio should be maintained for the quality of the intended work. Our observation insures that in some of the sites workers who has no concept of the mixture are doing this important duty. And too much or little water spoils the concrete. In some cases the measuring objects are broken some of the material is splashed before it enters in the mixer. Later on the strength of the structure will be compromised and unsafe.

Concrete vibration: After mixing the concrete pouring in to the formwork of columns, beams and slabs is accompanied by concrete vibration. Too much vibration or too little vibration have detrimental effect on the concrete quality and strength eventually. In some of the sites activity of improper vibration of casted concrete is the cause of many

structural elements to lose their intended strength. So the workmanship role is very important.

Watering the concrete: This seems to be a simple task. But this is part of workmanship. Unless we shower the concrete structures after casting for several days, they will not attain the required strength. In many sites due to the lack of this important activity the safety of the structures is at stake.

Soil compaction: As part of workmanship proper compaction of good soil in the basements will secure the stability of the structure or the entire building. Some contractors overlook this important task and make the entire building at risk. If soil is not properly compacted it may settle in the future time and settlement of foundation pads may end up in collapsing the entire building.

Work precedence: Very good workmanship maintains precedence of activities. If we do things in order we shall save time & money. In some projects because of lack of precedence machineries become idle, some works may be spoiled like concrete. I remember a certain site ordered bulk concrete and crane was mandatory to cast the concrete. Because the crane was late concrete was spoiled before being casted. Concrete sets and changes its behavior easily.

Construction activities on environment and public safety:

Effect on the environment. There is no doubt, construction activities affect the eco system fauna & flora in many ways. It displaces people, destroys trees and plants and affects wild life. It also contributes to global warming which is a threat to humanity. So as much as possible contractors and all stake holders need to work together to minimize harm to environment.

Public safety: When we see construction activities going on Addis Ababa how does researcher evaluate? The public is seriously affected displaced and face so much inconvenience due to construction activities. Roads are blocked, business are closed, and people get trouble because of transport facilities. Some project sites use public roads to store their material like sand, rock, soil, reinforcement. Due to blockage of roads accidents happen because of congestion or an informed drivers may run over this materials during night time. Safety signs are not put to warn the people around the construction area. This makes the people safety at stake. Manholes and excavated holes should covered before animals or people get in to them. People displaced or affected by the construction activity must be compensated to make the construction sustainable and inclusive.

Waste material handling: one way of measuring environmental protection is how construction wastes are treated. Contractors do not recycle materials to use them again to minimize pollution. By doing so they will also save money. Reusing materials unless they finished service life. Such practices are not satisfactory in the researcher's observation. Large mass of demolition is simply sold for other users or use them as fuel source. Some burn construction wastes. By doing so they will pollute the atmosphere and contribute for global warming. The other common practice is dumping construction wastes on farm lands. By luring farmers with little benefit the land will be covered by soil or waster. That will change the natural landscape in to a pile of artificial terrain. The green plantation will covered and destroyed. Using riverbanks and lower lands is also a common practice. Rivers are the main sources of water for dam, irrigation and

recreation. If construction activities affect this precious natural resource, pollution disease outbreak will be the consequence.

Quarry places: Selected soil and rock for masonry, fill or aggregate production, the earth is being excavated vastly. In this places massive excavations destroy plantation, displace animals and leave the place in a chaotic manner. Explosives are used to blast the rock for aggregate production. Animals will migrate and villagers may be disturbed because of the sound coming from the blasting. Finally when projects are completed contractors should make reinstating efforts to compensate the already damaged land. In order to fill the created space they need to fill it with soil coming from foundations excavations. Planting trees and giving access to villagers is also important.

4.2 From Open Ended questions and respondents' answer

For over all recommendation about safety concerns and to minimize material loss, harm to the public and the environment we can put below some of the respondent's opinions.

1. "In my opinion the construction safety concern in general here in our nation extremely poor. There is no such an awareness of construction safety in the construction industry. When we see the construction industry in our nation we all know it is booming due to different obvious reasons. But the knowledge regarding how to do construction and the skills are not developed well. Most of the people in the construction industry has learnt through experience (it is a trial & error).

There is no proper practical way of learning on the construction safety & also the rules and regulation on this matter are not experienced or practical here. I believe the rules are written very well but when it comes to practice, the construction cost will be more expensive, if the

construction has to fulfill all the requirements regarding public & environmental protection and construction safety.

In addition the procedure to get a project contract is obvious that the contractor should be a least bidder. Therefore this step will push the contractor to minimize his expenses. Because of this the bidder contractor will not consider construction safety in to consideration.

Hence recommendation will be:

- The government has to take a lead to instruct & give awareness to the people in this sector
- Enforce the rules & regulations
- Budget for construction safety & public environment protection should be put on the bid list."

2. "The primary reasons why safety material loss and environmental concerns are not prioritized are financial and awareness related. First the concerns are not properly itemized in the construction budgets. Which means they are not factored in when profit margins are set. I believe they should be given as a known factor (constant) for every construction project.

Regardless of size of projects, as a rule, a certain percentage should be dedicated. That is similar across the board irrespective of bidding price. Second, the parameters for level of success of a project must grade these items as mandatory. The successful completion of a construction project shall mean to involve these materials not only time & cost. Quantitative aspect of grading whereby a project will be labeled based on performance on these matters is very important.

To achieve this awareness creation visa vis media outlets , education outlets etc must ve done aggressively. Accident reporting is not enough, rather, projects that meet the

standards mentioned above must be celebrated and those that fail must be held accountable. It is better to build less & achieve these standards as nation, than to construct in a frenzy, with complete disregard to safety and environment."

3. Regarding safety in the construction sector we are, I mean, in Ethiopia very far from the rest of the world safety concerns. We are considering human being as use and throw material according to my experience. No one cares about the daily workers including myself. The government should be concerned about this reality and put mechanism of control.

4. It is better to give safety training, provide safety tools & equipment, follow up, evaluate, control, as well as remedial actions.

To have lows & regulation on public & environment safety mechanisms. In addition assigning of concerned bodies or entities on these issues to minimization and avoiding of accidents & harms.

5 Concerns with regard to environmental and public safety should take in to account practical capacity of the consideration in relation to cost-benefit returns of mitigating the harms. Especially when it comes to safety concerns that do not threaten public life. There are meticulous procedures being followed by clients and consultants that are imposed on contractors in association with minimizing material loss and impact on environment. But the cost of mitigating such concerns is too much to bear. Contractors in our country carry the burden alone to mitigate this loss through unpaid machinery works or fuel cost. But this will have a negative effect on the overall contractors' performance.

6 Environmental impact assessment health and safety should be included in every construction project as paid items so that contractors will be inspired to apply those issues in every construction project.

7 Every parties involved in construction site have to use helmet, safety shoes and gloves

- Using right material in the right place like scaffoldings which support cantilevers
- Mixer oprators need to dress properly so that they can prevent inhaling of fine particles like cement and sand.
- The entire building has to be covered so that they can minimize falling of objects and material.

8 As far as we know all the community don't recognize regarding about the effect of poor construction in the environment. So, first of all it is better to give the basics about unsafe construction and its impact. In other words it is better to give knowledge to the community in the construction firms, how to use material safety. Using recycle materials, fixing and repairing formworks, reinforcement bars and demolition concretes. According to the design.

Provide thorough knowledge or awareness for the workers how to use machines like grinder, drilling machine safely. Provide knowledge for daily laborers how to protect themselves from dust, welding sparks and protect eye injury.

9 To insure safety of the environment:

- Routine trainings should be given for professionals and other stake holders.
- Strict supervision regarding safety measures
- Facility for safety should be available on site
- General awareness of safety should be given for those involved in the sector.

10 Strong municipality rules and regulations and follow up or can be also monitored by external private firm. Giving incentives for those contractors who make effort to improve overall safety.

11 Lack of responsibility and negligence are the reasons behind most of the damages caused in Ethiopia. Therefore following proper construction procedures may solve majority of the problems.

12 As many researchers suggest, construction materials and equipment can keep environment and the public in danger. For this reasons use

- Every construction safety measures seriously.
- Implement waste management mechanisms.
- Use material efficiently with the help of quantity surveyor by professionals.
- Creating awareness about the importance of environment health and ecosystem
- Introduce renewable materials.

13 It is obvious that construction and safety should go together but it is not done in our country due to that many people lost their life. For this and to minimize the harm government should take the lead in implementing and controlling laws and regulations.

14 The construction sector shall be led by proper system and relationship between stakeholders with appropriate duty, responsibility and penalty. Safety is a prior issue in all standards, codes and manuals. But currently it is totally ignored. Strong measures must be taken to address this serious issue. Construction without safety cannot be sustainable.

15 Each and every individual participating in the sector should take measures to keep the public safe and protect the environment. More over rules and regulations must be implemented by the government. And the construction sector should be dominated by professionals otherwise damages will continue to happen in the future.

16 Construction sites must put safety signs. Protection and awareness creating in meetings to minimize accident rates in and around construction sites and plant greenery & trees around construction site after completion of the project.

17 As we all know the construction activities harm the public & the environment unless we do with a great care and awareness. In my opinion there is no enough attention and action taken by the regulatory body to control and supervise the projects according to safety standards.

18 Regarding the government:

- There must be rule and criteria when giving construction license/ renewing construction license to fulfill the safety staff, tools, professionals, safety manuals etc
- There has to be periodical control by government
- There should be workshops, trainings, experience sharing between contractors and authorities.

Regarding Consultants:

- The consulting firm should support the government in pointing out ideas that can be used for input policy making, training, document preparation etc
- The consuling firm should control as per the setted criteria
- The consulting firm should work ethical in controlling quality as well as the safety of the works and workers.

Regarding Contractor:

- The contractor should endeavor to innovations, new ideas and trainings.
- The contractor should make orientation about safety on site or project for better performance as well as quality.

19 Provide safety materials for workers and control properly. Design should be prepared by professionals and they should be checked by the government. Construction waste should be properly disposed without affecting the environment & the people who live nearby. Safety signs must be placed whenever necessary. Only use material of good quality.

20 In this country safety teachings are not included in the curriculum. So students or future engineers will not be sensitive when they are assigned in the projects. There are no enough enterprises to check and control quality and safety. Many sites in Addis Ababa city have problem of dumping places. They are not done in organized manner and special place should be allocated for this purposes. The public is affected by construction activities and roads are blocked. Even if safety clothes are provided to workers they may not use it because they are not that much conscious about safety and risk.

In some cases designs are being copy and pasted and not done in detail. This creates so much hassle when it is to be implemented in the project sites. This is among the factors that make projects not safe.

4.3 Findings from closed ended questionnaires:

Quantitative data were collected from active construction sites in the city. The quantitative data have been analyzed using Statistical Package for Social Sciences (SPSS) in which different statistical tools, including percentages, frequency tables, and charts were used in presenting the findings. Structured questionnaires were prepared in Likert scale type and were five categories that the researchers thinks to measure safety in the construction sites. Of the questionnaires dispersed 44 respondents effectively were willing to fill the questionnaires. One table is about workers safety to evaluate the projects in the scales:

On workers Safety: How do you evaluate the project site on workers safety with the following key points?

First the researcher checks the reliability or internal consistency of the ordinal type data with

Cronbach's-α coefficient using SPSS. Coofficient value >= 0.7 will be ok.

Table 4.1 Composition of respondants

Statistics

		Years in business	Capital of company	No of Employees
N (number of respondants)		44	44	44
	Missing	0	0	0
Median		6-10yrs	10-20million	21-50
Mode		6-10yrs	10-20million	>50

In all of the questionnaires the above table is the summary of the companies regarding years in the business, capital of company and no of employees.

Table 4.2 Questionnaire on workers safety

Qs.	**I. On workers safety** How do you evaluate the firm regarding: (1=poor, 2=fair, 3=good, 4=very good,5=excellent)	1	2	3	4	5
1	Culture of preparing and using manual for workers safety?					
2	Periodical safety training for workers?					
3	Providing safety shoes, helmets, goggle for workers?					
4	Enforcing & controlling workers for using safety kits?					
5	Insurance coverage for workers?					
6	Qualified person & medical facilities in case of accidents?					
7	Availability water and sanitation for workers?					
8	Assignment of safety officer at site?					
9	Keeping records of accidents in the construction site?					
10	Taking lessons learned from accidents in construction site?					
11	In sharing ideas or best practices from other contractors regarding accidents?					
12	In creating awareness or providing information to workers of epidemic diseases like HIV Aids?					

Table 4.3 test for reliability

Reliability Statistics

Cronbach's Alpha	N of Items
0.906	12

Cronbach's alpha is a measure used to assess the reliability, or internal consistency, of a set of scale or test items. In other words, the reliability of any given measurement refers to the extent to which it is a consistent measure of a concept, and Cronbach's alpha is one way of measuring the strength of that consistency. The resulting α coefficient of reliability ranges from 0 to 1 in providing this overall assessment of a measure's reliability. If all of the scale items are entirely independent from one another (i.e., are not correlated or share no covariance), then $\alpha = 0$; and, if all of the items have high covariances, then α will approach 1 as the number of items in the scale approaches infinity. In other words, the higher the α coefficient, the more the items have shared covariance and probably measure the same underlying concept. (Goforth, 2015)

As we can see from the above table, the coefficient is > 0.7 internal consistency of the data taken is acceptable.

Table 4.4 The frequency tables and descriptions

Statistics

	Question-1	Question-2	Question-3	Question-4	Question-5	Question-6	Question-7	Question-8	Question-9	Question-10	Question-11	Question-12	Combined Question
N (number of respondants)	44	44	44	44	44	44	44	44	44	44	44	44	44
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0
Median	fair	poor	good	fair	good	fair	good	fair	fair	fair	fair	poor	fair
Mode	poor	poor	good	fair	fair	poor	fair	poor	poor	poor	poor	poor	fair

a. Multiple modes exist. The smallest value is shown

*44 is the total number of respondents in every question of workers safety.

When we see the statistics of the workers safety the central tendency median and mode values are more of fair and poor performance of the projects. That means projects in Addis Ababa are not safe for the workers according to this study. The age of most of the companies with central tendency mode indicates between 6-10 years of experience. The capital of the companies fall in the range of 10-20 million birr. So the result of the survey indicates links with the experience or financial capacity of the contractors.

Frequency table:

For simplicity rather than analyzing Likert scale (attitude scale) answers of 12 questions we tried to combine the questions to get frequency table as well as histogram of the following using SPSS. The researcher used the median to combine all questions and try to understand end result tendency.

Table 4.5 statistical output for combined questions

	Frequency	Percent	Valid Percent	Cumulative Percent
poor	7	15.9	15.9	15.9
fair	22	50.0	50.0	65.9
good	10	22.7	22.7	88.6
very good	5	11.4	11.4	100.0
Total	44	100.0	100.0	

When we look at the combined frequency table of the 12 questionnaires we can see the fair and poor opinion responses summing up to be 65.9% of the answers. That means of the 44 respondents 65.9% of them have either poor or fair evaluation for workers safety parameters. It is also consistent with the mode and median table covered above.

Histogram: The histogram chart is also showing the same result of ‘fair’ opinion to the highest frequency. Code “2” means respondents evaluated the contractors with fair rank which is consistent with the frequency table above.

With workers safety evaluation the contractors performance according to the respondents is mostly fair and poor.

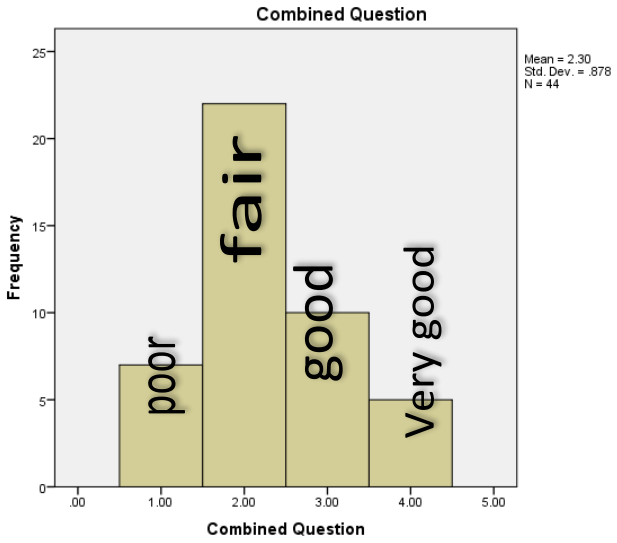

Figure 4.1 Histogram for workers safety

Impact of design & supervision on construction safety

How do you evaluate the project regarding the supervision and design?

Table 4.5 Questionnaires on the design & supervision impact for safety

	I. Impact of design & supervision on construction safety (1=strongly agree, 2=agree, 3=undecided, 4=disagree 5=strongly disagree)	1	2	3	4	5
1	Poor design could be a reason for building failures in Addis Ababa city.					
2	Shortage of experienced professionals is the reason for poor design.					
3	Clients are not well aware of choosing the right professionals for safe design construction.					
4	Bad supervision causes defective and unsafe construction.					
5	Some supervisors demonstrate unethical supervision practice.					
6	Construction firms should play a role in fighting unethical practices by supervisors for safe construction.					
7	Laws & regulations by the municipality are important to maintain design quality and construction safety.					

The above ideas were presented to get respondents opinion about the construction companies. The statistics table shows that the mode value to be code “2” and many others chose code “1” which stand for “agree” & “strongly agree” consecutively.

The ideas listed above are talking about shortage of professionals, poor design, lack of awareness of the clients about the necessity of safe design, unethical behaviors exhibited by supervisors and the role of laws and regulations.

So respondents say all this issues are important and should be improved for the safety of the projects.

First the researcher checks the reliability or internal consistency of the ordinal type data with Cronbach’s-α coefficient using SPSS. Coofficient value >= 0.7 will be ok.

Table 4.6 Reliability test of the design & supervision impact for safety

Reliability Statistics

Cronbach's Alpha	N of Items
0.698	7

As we can see from the above table, the coefficient is almost equals to 0.7 internal consistency of the data taken is acceptable, but it is slightly below expected.

Table 4.7 table of central tendency of respondents

Statistics

	Question-1	Question-2	Question-3	Question-4	Question-5	Question-6	Question-7	Combined Q
N (number of respondants)	44	44	44	44	44	44	44	44
Missing	0	0	0	0	0	0	0	0
Median	agree	agree	agree	agree	agree	agree	strongly agree	agree
Mode	strongly agree	agree	strongly agree	strongly agree	agree	strongly agree	strongly agree	agree

Table 4.8 Frequency table:

Combined summary of all Questionnaires

	Frequency	Percent	Valid Percent	Cumulative Percent
strongly agree	11	25.0	25.0	25.0
agree	26	59.1	59.1	84.1
	1	2.3	2.3	86.4
undecided	5	11.4	11.4	97.7
disagree	1	2.3	2.3	100.0
Total	44	100.0	100.0	

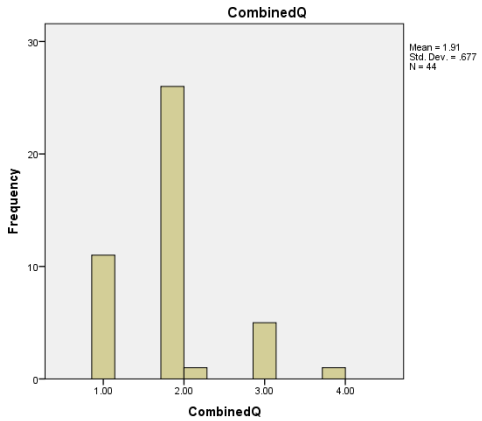

Figure 4.2 Histogram of impact of design & supervision

The frequency table and the histogram shows similar output values with the central tendency the mode and the median.

So quality design and supervision has association with safety. Its positive impact when performed well is very high. Its negative consequences when it is done with lack of care, lack of

professionalism is very costly for human safety, for wastage of material and time overrun of the projects.

Awareness of the owners or clients plays role in being dedicated to choose the experienced and educated professionals to assign the right person for the right task.

Material quality and construction safety:

(Please tick: 1=very dissatisfied, 2=dissatisfied, 3=Neutral, 4=Satisfied, 5=Very satisfied)

Table 4.9 Questionnaires on material quality and safety

	I. Correlation between material quality and construction safety: (Please tick: 1=very dissatisfied, 2=dissatisfied, 3=Neutral, 4=Satisfied, 5=Very satisfied)	1	2	3	4	5
1	Regarding use of the right formwork material.					
2	Regarding laboratory facility for quality test & follow up like concrete, reinforcement or soil?					
3	Regarding proper storage of materials without losing their quality like cement and reinforcement?					
4	Regarding purchasing the right quality of material from market?					
5	Regarding removing materials when they do not meet required quality?					
6	Material safety data sheet?					
8	Material safety controller?					

Table 4.10 Internal Consistency of the data collected

Reliability Statistics

Cronbach's Alpha	N of Items
.890	7

As we can see from the above table, the coefficient is > 0.7 internal consistency of the data taken is fine.

Table 4.11 Central tendency of the data

Statistics

	Question-1	Question-2	Question-3	Question-4	Question-5	Question-6	Question-7	Combined Q
N (number of respondants)	44	44	44	44	44	44	44	44
Missing	0	0	0	0	0	0	0	0
Median	Satisfied	Satisfied	Satisfied	Satisfied	neutral	neutral	neutral	neutral
Mode	Satisfied	Satisfied	Satisfied	Satisfied	neutral	neutral	neutral	neutral

Respondents from the frequency table chose half of them dissatisfied and the remaining answered with dissatisfaction.

Table 4.12 Frequency Table:

Combined summary of all Questionnaires

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	dissatisfied	7	15.9	15.9	15.9
	Neutral	16	36.4	36.4	52.3
	Satisfied	13	29.5	29.5	81.8
	Very Satisfied	8	18.2	18.2	100.0
	Total	44	100.0	100.0	

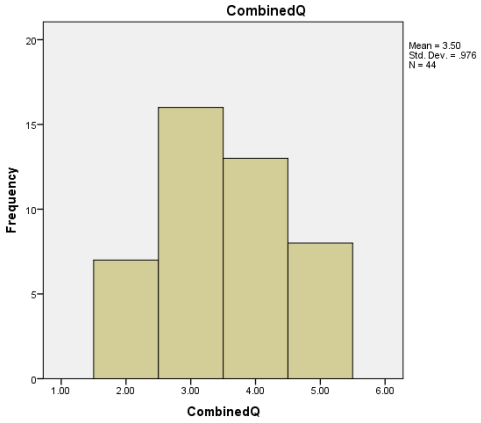

Figure 4.3 Histogram

The evaluation output from the frequency table and the histogram shows 52.3% of the answers are dissatisfaction and neutral response. And 47.7% give responses of satisfaction. So contractors in this evaluation are better than the previous evaluation parameters. But still material quality is compromised substantially according to this assessment. Formwork or temporary structure is not done with the required strength and quality material. Many sites do not have laboratory facilities in their sites to check and test material quality. Purchasing also needs great care. Bad materials are purchased and used even if after being aware they don't meet the required quality. Materials are kept carelessly and they eventually lose their intended standard because of handling. Defective works are lest as they are which will result in making the entire structure or building unsafe. Records and data for the materials is not well done in many sites.

Workmanship & Construction Safety

How do you evaluate the project site regarding:

Qs.	I. Workmanship & Construction Safety How do you evaluate the project site regarding: (1=poor, 2=fair, 3=good, 4=very good,5=excellent)	1	2	3	4	5
1	Assigning skilled and experienced workers in the site.					
2	Training & upgrading skilled workers.					
3	Monitoring workers for placing materials as per the design.					
4	Supporting skilled workers with technological devices.					
5	Allocating workers with proper work load.					
6	Motivating & rewarding skilled workers for good performance.					
7	Replacing workers with poor performance.					
8	Taking action against or demolishing defective works.					
9	Proper concrete mix ratio & mixing.					
10	Proper concrete vibration.					
11	Watering the concrete after casting.					
12	Proper soil compaction?					
13	Proper anchoring & placing of reinforcements.					
14	Maintaining work precedence.					

(1=poor, 2=fair, 3=good, 4=very good,5=excellent)

The project sites were evaluated by respondents in terms of assigning skilled and experienced workers in the site. Without skill and experience knowledge is worthless. The other point was training & upgrading skilled workers. This is also very important for a good performance & safe construction.

Monitoring workers for placing materials as per the design and supporting skilled workers with technological devices were also evaluation points. Allocating workers with proper work load, work load should be measured. Some workers should not be overloaded because they perform well. Or they should be paid with proportional wage to compensate the work load.

Motivating & rewarding skilled workers for good performance and replacing workers with poor performance is another point of focus for the respondents to evaluate.

Taking action against or demolishing defective works is also checked as a safety measure.

Proper concrete mix ratio & mixing, proper concrete vibration and watering the concrete after casting, proper soil compaction proper anchoring & placing of reinforcements also evaluated under this questionnaire. Maintaining work precedence also evaluated because contractors should do first thing first to minimize wastage, boost performance save time.

Table 4.14 Internal Consistency of data:**Reliability Statistics**

Cronbach's Alpha	N of Items
.913	14

As we can see from the above table, the coefficient is > 0.7 internal consistency of the data is excellent.

Table 4.15 Central Tendency of Responses

Statistics														
	Question-1	Question-2	Question-3	Question-4	Question-5	Question-6	Question-7	Question-8	Question-9	Question-10	Question-11	Question-12	Question-13	Question-14
N (number of respondants)	44	44	44	44	44	44	44	44	44	44	44	44	44	44
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Median	good	fair	good	good	good	good	good	good	good	good	good	good	good	good
Mode	very good	fair	good	fair	good	good	fair	good	very good	very good	very good	fair	very good	good

The statistics for the workmanship evaluation shows clear outcome. The mode is code "2" that means contractors are graded mainly with only fair mark. This shows respondents have dissatisfactory responses with the performance regarding workmanship of the project sites

Table 4.16 Frequency Table:

Combined summary of all Questionnaires

	Frequency	Percent	Valid Percent	Cumulative Percent
poor	3	6.8	6.8	6.8
fair	10	22.7	22.7	29.5
good	18	40.9	40.9	70.5
very good	11	25.0	25.0	95.5
excellent	2	4.5	4.5	100.0
Total	44	100.0	100.0	

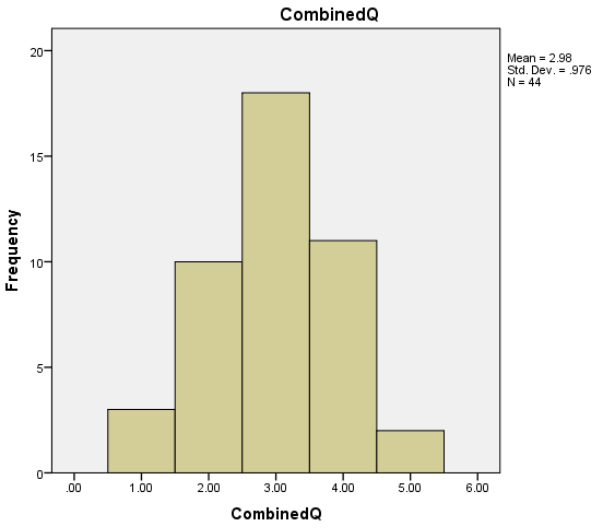

Figure 4.4 Histogram, workmanship & safety

The frequency table shows that >70% of the answers are between poor and good. That means contractors workmanship is not as good as it should be. Because most sites lack sufficient experienced and skilled workers. Training and upgrading culture is not developed. Many contractors do not use technological devices to support their workers. Motivation of good workers will help to minimize workers turn over. Closely monitoring workers for doing works as per the design is vital. When defective works are found action may not be taken to rework. Concrete mix and vibration may not be conducted so well. This may create cracks, segregations. This is observed in many sites. Work precedence may not be kept well. Hence respondents evaluation indicates the lack of all the above important activities.

Construction activities on environmental and public safety

Please choose opinion

(1=always, 2=sometimes, 3=rarely, 4=never, 5=I am not well informed)

Respondents were also asked to evaluate project sites with following points. Construction activities can harm the environment and ecosystem. Companies should takes care for the public affected by construction activities. Project offices should be checked whether or not they use public roads to store material like sand or gravel. Recycling and reusing construction wastes is another way of keeping the environment from degradation. Burying or burning construction wastes may not be always wise since some materials like plastic may take 100s of years to decay.

Respondents also gave their evaluation about disposing excavated soil & construction wastes to open land. Which will make the natural face to be filled by debris. Farming lands will be affected. Grazing spaces for animals will be minimized. Constructors also should be evaluated in terms of disposing excavated soil & construction wastes to riverbanks. Reinstating quarry sites for rock and selected soil after use is another point of discussion. Quarry places should be restored to their original form after use.

Using cart away materials to fill quarry places after use is a wise action to fill old quarry sites.

Putting safety signs to make aware the public, covering manholes and excavated holes to prevent harm is very important point of evaluation.

Compensating people affected by construction activities. Planting trees and greenery for environmental protection. Generally minimize affecting the ecosystem. Are the key points to evaluate contractors to minimize waste, harming the public and the environment at large.

Table 4.17 Reliability test

Reliability Statistics

Cronbach's Alpha	N of Items
.320	14

	I. Construction activities on environmental and public safety Please choose opinion (1=always, 2=sometimes, 3=rarely, 4=never, 5=I am not well informed)	1	2	3	4	5
1	Construction activities can harm the environment and ecosystem.					
2	My company takes care for the public affected by construction activities.					
3	Project office uses public roads to store material like sand or gravel.					
4	Recycling and reusing construction wastes.					
5	Bury or burn construction wastes.					
6	Dispose excavated soil & construction wastes to open land.					
7	Dispose excavated soil & construction wastes to riverbanks.					
8	Reinstating quarry sites for rock and selected soil after use.					
9	Using cart away materials to fill quarry places after use.					
10	Putting safety signs to make aware the public.					
11	Covering manholes and excavated holes to prevent harm.					
12	Compensating people affected by construction activities.					
13	Planting trees and greenery for environmental protection.					
14	Minimize affecting the ecosystem.					

As we can see from the above table, the coefficient is way< 0.7 internal consistency of the data is poor.

Table 4.18 Central Tendency of responses

Statistics														
	Question-1	Question-2	Question-3	Question-4	Question-5	Question-6	Question-7	Question-8	Question-9	Question-10	Question-11	Question-12	Question-13	Question-14
N (number of respondants)	44	44	44	44	44	44	44	44	44	44	44	44	44	44
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Median	sometimes	sometimes	sometimes	rarely	rarely	sometimes	rarely	rarely	rarely	sometimes	sometimes	sometimes	rarely	rarely
Mode	sometimes	sometimes	sometimes	rarely	rarely	sometimes	never	sometimes	sometimes	sometimes	always	always	rarely	rarely

Table 4.19 Frequency table

Combined summary of all Questionnaires

	Frequency	Percent	Valid Percent	Cumulative Percent
sometimes	21	47.7	47.7	47.7
rarely	23	52.3	52.3	100.0
Total	44	100.0	100.0	

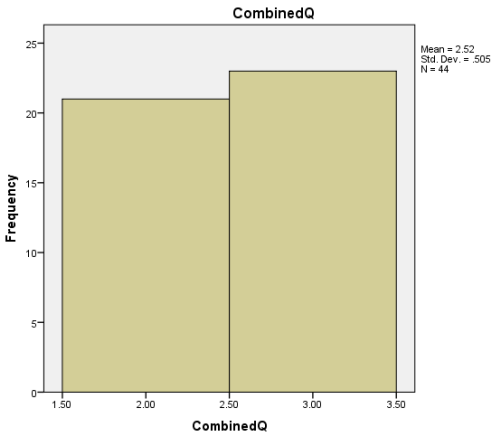

Figure 4.5 Histogram, impact of construction in environment and public safety

The quality of the data of the respondents not normally distributed according to the test. However most of the answers for the commitment of the contractors for the action proposed are rarely and sometimes. This shows reservation of respondents about their observation in terms of the above factors namely: putting proper safety signs, proper waste disposal and management, compensation of the people affected, planting trees and greenery to maintain natural conservation. Reusing and recycling of materials for effective and efficient use of resources.

5. Conclusions:

Safety is a crucial issue for the current massive construction activities ongoing in Addis Ababa city. To be aware of safety, stake holders mainly contractors should know the different aspects of it. The main players in the day to day construction duties are workers. The other contributory aspect is a very organized design and supervision body. The third important contributor to safety is the necessary material with the right specification and standard. The fourth important factor for construction safety is workmanship of the actual works. Just having the correct design and quality material will not guarantee the safety of the project unless it is supported by the right and competitive workmanship. The final aspect which should never be forgotten is the impact made to the environment because of this massive developmental construction activities. Any human activity that affects or degrades the environment will have negative payback. The scale of impact by construction projects is huge. If we ignore detrimental effect of the construction activities the entire developmental plan will not be sustainable or will not be able to hit the target.

Humanity is now being challenged by many existential threats like population explosion, migration, extremism, nuclear arsenal and global warming. Global warming has become one of the burning issues of contemporary global leaders. Since human activities are behind this phenomenon. Warming mother planet earth has a very dangerous consequence. It may even be a reason for extinction of the human race. One of the major contributor of such activities is construction and urban developments. Raw materials for construction come from the forest, which will affect the green plantations. So much excavation and blasting is made to get steel and other materials to be used for it. Duet to population increase and unlimited human needs big cities are being built all over the world. Buildings inside cities trap the sun's temperature and make the globe

to warm. Warming the planet will melt the ice bergs and destabilize the natural state of environment. Elnino in the form of floods, draughts & famine happen all over the world.

In this respect the mini research made in the construction sites in Addis Ababa city indicates that there are so many safety concerns. The researcher's observations from experience, the respondents' free opinions and answers from the structured questions all say safety among the contractors is not a serious agenda. Workers are engaged in their duty without the necessary protection. They are vulnerable for various risks. They don't have clothing for safety, scaffoldings are not strong enough and workers also are affected from slides coming from excavated soils. First aid facilities and health professionals are not assigned at site to minimize human cost when accidents and injuries happen. The lack of exercise of professionalism by supervisors and enough follow up many things are done compromising the qualities and standards. Some supervisors involve in unethical or corrupted practices in exchange of loosening their control of material quality and precedence.

Some contractors try to save spending by delivering materials that do not meet quality requirement. Reinforcement bars, cement, sand, selected soil and other materials may be poor quality. This affects the safety of the structure and its life period.

Workmanship is also critical for the safety of the buildings. Unqualified and inexperienced employees can't interpret and put materials as per the design. It is not uncommon to see cracks, segregations, and unsound concrete structures in Addis Ababa building structures. Sometimes collapsing of buildings happen before even it is completed.

The other point is the contractors do not assign sufficient work force in the sites. Many workers are overloaded to do multiple works or too much works. In the researcher's experience of visiting

the sites 1-2 engineers are assigned for building G+12 or more. Overload affects the quality of the workmanship because enough follow up and coverage of the entire activities will be difficult.

Safety for the environment and the public is not also satisfactory according to the results of this research. Construction waste management is poor. Cart away is made to farm lands or river banks. Quaries for rock and selected material are not well treated after use. Reinstating to their original form is not checked. Cutting of trees is not compensating by plantation.

The public is victimized by the construction activities. There are no enough compensations. Roads are blocked, businesses are closed, and movements are affected. There are no enough safety signs to warn people.

Not all the contractors are to be criticized because there are some who do their best to minimize affecting the ecosystem and the public safety.

6. Recommendations:

The successful completion of a construction project shall mean to involve safety consideration like workers safety, material quality, workmanship quality, well established design and supervision input and care for the environment and the public. Success should not be measured only in terms of time & cost. Quality must come first rather than quantity.

All stake holders, clients, contractors, professionals, government need to do in collaboration on construction safety in order to minimize loss of life and material as well as minimize harm to the environment.

To achieve safe construction other players like media outlets, education outlets do and contribute very well. Records on accident reporting should be done for this outlets in order to create awareness and keep lessons learned to avoid repeated incidents on other project sites. Projects that meet the standards mentioned above be celebrated and those that fail to meet be held accountable. It is better to build less & achieve these standards as nation, than to construct with complete disregard to safety and environment protection.

- Establishing responsible institutions for building safety and quality assurance will safeguard safety.
- It is better the government take the lead to provide awareness to the people in this sector and enforce the rules & regulations.
- Budget for construction safety & public environment protection better be put on the bid list.

- Include safety part of the curriculum in educating engineers and architects.

- Ethics and safety go hand in hand. Professionals better be set and educated to be ethical, perform duties with integrity which is a precursor to exercise professionalism.

- Encourage construction sector for its challenges. Many contractors suffer due to cash flow and financing. Financial sectors better work with this industry as it is capital intensive. Government better have policy to allow contractors to have access to finance whenever projects need. Payment delays and long process of getting loan from banks is a major headache to many contractors. This has direct and indirect influence in maintaining the overall safety of the projects.

- Professional associations and contractors associations would rather be strengthened in such a way to bring change. Meetings and conferences be media of change rather than just conducting discussions. They better invite authorities to make them aware and give insight for new policies that has meaningful impact in the construction arena.

Construction safety consideration is required at all stages of construction process which are, feasibility stage, design stage, construction stage, operation stage. Safety should also be important while conducting demolition of existing structures.

References

Allopi, D. (2014). *Impact of Inadequate Experience and Skill on the Construcion Sector in KwaZulu-Natal, South Africa.* Durban: Department of Civil Engineering & Surveying Durban University of Technology.

Ametepey, S. O. (2015). *Impacts of Construcion Activities on the environment: The Case of Ghana.* Kumasi: Department of Building Technology, Cape Coast Polytechnic.

Arkebe, O. (2015). *Made in Africa.* England: Oxford University Press.

Behm, M. ,. (2011). *Safe Design in Construction: Perceptions of Engineers in West Australia.* Ballarat: J Health & Safety Research & Practice.

Benton, W. J. (2010). *Construcion Purchasing & Supply Chain Management.* New York: The McGraw-Hill Companies, Inc.

Commission, N. P. (2016). *Growth and Transformation Plan II.* Addis Ababa: Federal Democratic Republic of Ethiopia.

Construction-Association, T. R. (2005). *Construction Safety Handbook.* Hong Kong: The Real Estate Developers Association of Hong Kong and The Hong Kong Construction Association.

Council, I. C. (2010, April). *Building Safety Journal.* Retrieved from http://bsj.iccsafe.org/april/features/haitip2.html: http://bsj.iccsafe.org

Femi, O. T. (2014). *Effects of Faulty Constrction on Building Maintenance.* Lagos: INTERNATIONAL JOURNAL OF TECHNOLOGY ENHANCEMENTS AND EMERGING ENGINEERING RESEARCH.

Fengshou, Q. (2016). *Reinforcement of Safety Awareness Training to Construction Workers in Subcontracted interprises.* Shanghai: Songjiang University Town.

Goforth, C. (2015). *Using and Interpreting Cronbach's Alpha.* Virginia: University of Virginia Library.

Greenwood, D. J. (2003). *Construcion skills requirement issues in Zambia.* Brighton: Association of Researchers in Construcion Management.

Keys, D. (2016, January 4). *Architecture of Ethiopia*. Retrieved from Wikipedia, the free encyclopedia: https://en.wikipedia.org/wiki/Architecture_of_Ethiopia

Kishore, K. (2015). *Setting Up small Testing Laboratory at Field.* Patiala, India: Civil engineer portal website.

Krigsvoll, G. (2010). *Sustainability in Construction.* Oslo: Oslo University College,.

Labor, U. S. (2017). *Protective Clathing & Equipment.* Washington DC: Occupational Safety and Health Administration .

Malkin, B. (2013, May 23). *Telegraph.* Retrieved from The telegraph website: www.telegraph.co.uk

Mcgarvey, S. (2013). *The construction chart book.* Georgia Ave: The Center for Construction Research and Training.

Mervyn Jones, D. (2001). *Sustainable Construcion Working with the community.* UK: Building Research Establishment Ltd 200.

Morgan, L. A. (2010). *How to Conduct a Workplace Health & Safety Inspection.* California: California State University Employees Union.

Mötzl, H. (2011). *Environmental and health related criteria for.* Vienna: Austrian Institute for Healthy and Ecological Building.

Nemati, K. M. (2007). *Introduction to Concrete Formwork and Vartical Formwork Design.* Washington DC: University of Washington Department of Construcion Management.

NIOSH, N. I. (2016). *Construction Safety and health.* New York: NIOSH.

Office, I. L. (1995). *Safety, health and welfare on construcion sites.* Geneva: ILO Cataloguing.

OSHA, O. S. (2005). *Pocket Guide for Worker Guide Serires.* Washingto DC: United States department of Labor.

Othman, N. (2014). *Poor Workmanship in Construction of Low Cost Housing.* Oradia: ANALELE UNIVERSITĂłII.

Practice, C. o. (2015). *First Aid in the work place.* Jeneva: Safe work Australia.

Qian Wei, S. Z. (2014). *The Bad Die Young.* New York: News China Megazine.

Toole, M. (2014). *Safety by Design, Civil & Envirnmental Engineering.* Lewisburg: Bucknell University.

Utterback, D. F. (2015). *Workers Compensation Insurance.* National Institute for Occupational Safety and Health.

Vaughan, J. (2014). *Ethiopia construction boom lays foundation for growth.* Addis Ababa: Agence France Press.